

Claims

- [c1]
1. A battery with built-in load leveling, comprising: a battery element; a capacitor element; an electronic controller to control complementary charge and complementary discharge between said battery element and said capacitor element; a single housing to adapt said battery element, said capacitor element, and said controller to provide a hermetic encapsulation; and two terminals by one positive terminal and one negative terminal, on the exterior of said housing for charging and for discharging.
 2. The battery with built-in load leveling as claim 1, wherein said battery element includes a primary electrochemical cell selected from the group consisting of Zn/MnO_2 , $\text{Zn/Ag}_2\text{O}$, and Zn-air batteries.
 3. The battery with built-in load leveling as claim 1, wherein said battery element includes a rechargeable electrochemical cell selected from the group consisting of lead-acid, nickel-cadmium, nickel-metal hydride, lithium ion, and lithium polymer batteries.
 4. The battery with built-in load leveling as claim 1, wherein said capacitor element has an energy density of 0.15F per 1 cm^2 of electrode area or greater than 0.15 F/cm^2 .
 5. The capacitor element as claim 4, wherein said capacitor includes an electrochemical cell selected from the group consisting of supercapacitor, ultracapacitor, and electric double layer capacitor.
 6. The battery with built-in load leveling as claim 1, wherein said battery element and said capacitor element both use the same aqueous electrolyte including one salt selected from the group consisting of KOH, NaOH, H_2SO_4 , and H_3PO_4 dissolved in water.
 7. The battery with built-in load leveling as claim 1, wherein said battery element and said capacitor element both use the same organic solvent selected from the group consisting of acetonitrile, propylene carbonate, ethylene carbonate, diethyl carbonate, and dimethyl carbonate.
 8. The battery with built-in load leveling as claim 1, wherein said battery element and said capacitor element both use a polymeric electrolyte.
 9. The battery with built-in load leveling as claim 1, wherein said controller regulates said battery element to discharge at 1C or a lower rate.

10. The battery with built-in load leveling as claim 1, wherein said controller regulates said capacitor element to provide a power gap between a load demand and a power provided by said battery element.
11. The battery with built-in load leveling as claim 1, wherein said controller regulates said capacitor element to extract all stored energy of said battery element before arriving at a cut-off voltage of said battery element.
12. The battery with built-in load leveling as claim 1, wherein said controller regulates said capacitor element to receive a charging current of any magnitude without exceeding an open cell voltage of said capacitor element.
13. The battery with built-in load leveling as claim 1, wherein while in a charging mode, said controller regulates said capacitor element to charge said battery element within an open cell voltage and an acceptable current level of said battery element.
14. An air-driven energy apparatus, comprising: a fuel used as reactant at an anode; an air cathode that uses oxygen as reactant; an in-cell air management system; a rechargeable electrochemical cell; a capacitor element, used to boost a power output of said rechargeable electrochemical cell to actuate said air management system; an electronic controller that first detects a load, then requests said rechargeable electrochemical to charge said capacitor element, and then requests said capacitor element to provide peak powers to actuate said air management system to generate an air draft in said air-driven energy apparatus; and a single container to adapt said anode, said cathode, said air management system, said rechargeable electrochemical cell, said capacitor element, and said electronic controller.
15. An air-driven energy apparatus as claim 14, wherein said fuel for said anode includes a chemical selected from the group consisting of hydrogen, methanol and ethanol.
16. An air-driven energy apparatus as claim 14, wherein said fuel for said anode includes a metal selected from the group consisting of aluminum, magnesium, zinc, and iron.
17. An air-driven energy apparatus as claim 14, wherein said air management system includes: at least two micro fans, at least two air inlets, and at least two air channels that are formed by pressing at least two protruding dots against

said air cathode.

18. An air-driven energy apparatus as claim 17, wherein the air management system can generate an air draft ≥ 10 ml/min in said air-driven energy apparatus.

19. An air-driven energy apparatus as claim 14, wherein said electrochemical cell is selected from the group consisting of Zn/NiOOH, Zn/MnO₂, and Zn/Ag₂O.

20. An air-driven energy apparatus as claim 19, wherein the electrochemical cell, with assistance of said capacitor element, can provide a power ≥ 0.5 W.

21. An air-driven energy apparatus as claim 14, wherein said capacitor element includes one selected from the group consisting of supercapacitor, ultracapacitor, and electric double layer capacitor.